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ABSTRACT

The status of computer-assisted language learning for elementary and secondary school limited-English-speaking students is reviewed, and recommendations for further research and development are proposed. The study was conducted through interviews with leaders in the field, site visits, classroom observation, attendance at workshops, and a review of the literature. The opening section provides background information and details of the study's organization. The second section discusses issues related to equal education and barriers created by limited English proficiency. The third section outlines common arguments in favor of computer assisted language learning and the major uses of computers in the field. These uses include direct instruction focusing on either form or message, and indirect language instruction through subject area study. The fourth section addresses issues in software development, evaluation, and dissemination and discusses specific software designed for use in teaching English as a second language (ESL) and for purposes other than ESL. The fifth section reviews recent research on aspects of computer-assisted language learning and presents recommendations for research and development concerning classroom computer use, teacher training, lesson design, and software evaluation criteria. A list of 86 references is appended. (MSE)

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USING COMPUTERS TO PROMOTE THE DEVELOPMENT OF ENGLISH AS A SECOND LANGUAGE

A Report to the Carnegie Corporation

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University of Arizona

November, 1985

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SECTION 1: INTRODUCTION

Limited English proficient students have been using computers for several years, but exploration of the ways they are using computers and the effects of such use have just begun. With increasing numbers of microcomputers in the schools, their appropriate use is a topic of much importance to educators. Paisley (1985) discusses the need to address three broad questions about children and microcomputers: (1) who uses computers? (2) In what ways? and (3) With what effects? The assumption is made by proponents of computer use that experience with computers in an educational environment can be a valuable part of a student's education and indeed should be, while others remain skeptical. This report addressess ways that computers can be used to promote the acquistion of English as a second language (ESL) by students who are limited in English proficiency (LEP).

Access to computers is a issue that must be addressed specifically for LEP students. To the extent that language minority students are systematically excluded from experiences using computers in school on the basis of their ethnicity, socioecomonic status, or English lanaguage proficiency, they are not being provided with experiences comparable to those of their peers and this could indicate that the system is continuing to follow deficit models of educating LEP students. For students who do have access, the philosophy regarding the purpose for using computers varies widely. Some programs are clearly remedial in nature, others are designed to provide enrichment, while others provide similar academic challenges to all students.

The challenge of defining various uses to which computers can best be put is complex and interesting. When the overall goal is to promote second language acquisition, computer-assisted instruction (CAI), commonly called computer-assisted language learning (CALL), is being increasingly used for LEP students in bilingual education, immersion, and other kinds of programs. Assuming that direct instruction in language, focusing on either language forms or communicative language use, is worthwhile

as part of an overall design for second language (L2) acquisition for LEP students, then questions of the quality and availability of ESL software need to be addressed. Experts generally agree that software developed specifically for ESL is poor and primarily of the drill and practice type. While better and more communicative CALL lessons are under development, educators in ESL and bilingual education are currently forced to survey the broad array of general education software, and either select or adapt software for their needs. There are few guidelines for them to follow. Uses of computers, beyond CALL, in ways that promote language learning for LEP students in grades K-12 have barely begun to be considered.

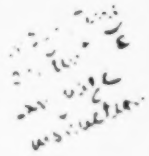
- We know little about the effects of computer use on the L2 acquisition of LEP students and related social, affective and cognitive characteristics of students who interact with computers. Research addressing issues beyond CALL/non-CALL comparisons has just begun and can build on insights from the literature from communication research, sociology, cognitive psychology, linguistics, education, and computer science.

Defining a Context for Examining Uses of Computers in L2 Acquisition

The first step in examining various uses of computers in promoting the development of English for LEP students is an explicit definition of some aspects of the context for English language learning. Consideration of context is necessary in order to establish a framework from which to explore how computers might best be used. The context for learning ESL is determined by: (1) assumptions about promoting the cognitive development of LEP students; (2) assumptions regarding the value and role of languages other than English in education; (3) information on how children and adolescents learn a second language at school and the related organizational features of classrooms; and (4) the ways in which computers can be used in education in general.

This survey was undertaken and the report written within a framework that includes the following two assumptions: (1) nonremedial, empowering approaches to educating LEP students have the most potential for producing

overall positive results; and (2) respect for students' cultural background and the use of and development of students' own language(s) lead to positive experiences and outcomes for LEP students. The contextual framework for the survey also includes the following two considerations: (1) opportunities for L2 learning (beyond "the ESL lesson") occur throughout the entire day, need to be carefully planned, and can be more profitable than traditional ESL lessons; (2) uses of computers for LEP students should be parallel to the best uses of computers for all students.



The Survey

This report is based on the findings of a short-term survey. The overall purpose of the survey was to examine the state of the art and current practices in computer assisted language learning (CALL) for LEP students in grades K through 12 and, based on the findings, to make recommendations regarding: (1) how computers might best be used in promoting the acquisition of English and (2) where the Carnegie Corporation might direct its research and development efforts.

The survey was conducted over a 20-day period by interviewing leaders in the field about their activities and their views of the state of the art in CALL and other uses of computers to promote L2 learning. Interviews were conducted primarily by telephone. Information was also gathered by visiting several projects, observing students in several classrooms, attending several workshops, and reviewing books, articles, and other documents.

Organization of the Report

The audience for this report is the Carnegie Corporation of New York. With this audience in mind the report is organized in a way that should be useful in providing a basis for examining proposals for activities related to promoting language learning using computers. Section II addresses issues of access to computers in school. In Section III different ways in which computers are being used and can be used to promote the acquistion

of English as a second language are discussed. Section IV addresses the development, evaluation, and dissemination of software and information about software. The final section provides a discussion of research and includes recommendations for future research and development efforts.

SECTION II: EQUAL ACCESS AND EQUAL OPPORTUNITY

Language minority students who are limited in English proficiency have fewer opportunities to use and interact with computers than do the general population of students. They often experience a double barrier, the first resulting from their being in low SES, primarily minority schools, and the second resulting from their lack of English proficiency. In addition, the opportunities that they do have to interact with and use computers are often qualitatively inferior to those of other students.

Is Equal Access an Important Issue?

Some writers (for example, Pogrow, 1985) suggest that equal access will soon be an issue of the past and that the microcomputer craze will fizzle because advocates and presumed experts know little about the learning process. A more optimistic view is that in addition to the craze to put a computer in every classroom, or in every college student's dormitory room (Tucker, 1983-84), significant efforts will be mounted to focus on how to use the machines to enhance learning and even to identify new things to be learned. In this case equal access will remain an important issue for language minority students. Adequate access will be an important issue not only because certain uses of computers may be found to enhance certain kinds of cognitive, social, and language development, but also because the need and opportunities to use them as tools at higher levels of education, in the work place, and in the home are continually increasing. Access and experience are important for both of these reasons.

Barriers Related to Minority Status and SES

Information on the extent to which LEP students are receiving opportunities to interact with computers is somewhat limited. Recently, however, a number of surveys have addressed broad questions regarding the uses of computers in schools (Ramirez & Vasquez, 1984; CSOS, 1983; COMSIS, 1984; Arias, pc, July 24, 1985). Some of these studies do not directly address uses of computers by language minority or LEP students; nevertheless,

some include reports on data broken down according to the socioecomonic status of the schools involved, the ethnic composition of the student populations involved, and the relative achievement levels of students. Because language minority students often have low achievement scores and are usually concentrated in schools in poorer neighborhoods with high concentrations of minority students, the results of these studies are important when examining issues related to using computers with students who are limited in English proficiency.

Becker, under contract to NIE and NCES, has conducted two national surveys of the instructional uses of computers in schools, one in 1983 and one in 1985 (Becker, 1985a, 1985b; CSOS, 1983) at the Center for Social Organization of Schools at Johns Hopkins University. Results of the first survey indicated that the predominantly minority schools in the sample had at least four patterns of microcomputer use that were different from those of the predominantly white low-SES schools in the study sample. In the minority schools computers were used more often for drill-and-practice activities rather than for programming. Secondly, predominantly minority elementary schools reported intensive use by below-average students, while low-SES-predominantly-white schools reported intensive use by above average students. Third, the minority schools were less likely to have a person on staff knowledgeable about computers. Fourth, the average student user in the minority schools got less computer time during the week even though the computers in these schools were used more hours per week.

Access to quality computer time. Becker concludes that patterns of use observed in white schools versus minority schools represent two very different philosophies regarding the appropriate role of computers in teaching. The low SES predominantly minority schools used computers in a compensatory manner, to raise achievement levels through drill and practice for low achievers. Educators in these schools seemed to be "trusting...[that] increased student motivation, immediate feedback, and individualization of instruction -- can be realized for the participating students" (CSOS, 1983, p.8). The other approach, he points out, is to

provide "faster-learning" students with a challenge so that they do not become bored while the teacher gives extra personal attention to the "slower-learning" students.

Becker states that is it not known which is the more effective way to use a limited number of microcomputers in low SES elementary schools, and that current use patterns may provide a focus for future research. With LEP students, however, there is no evidence that slower rates of learning in general should be assumed; they simply have more things to learn all at once than fluent English speaking students.

Building on work by the Center for the Social Organization of Schools, Arias, at Stanford, has conducted a survey on uses of computers in predominantly Hispanic schools in California (Arias, pc, July 24, 1985). She surveyed 20 high schools in California with high levels of Hispanic enrollment to determine the extent to which students had access to computers and the type of interaction they experienced. She found several kinds of barriers for Hispanic students in the sample schools. First, computers were most often under the control of math and science teachers, and Hispanic students were less likely to participate in these courses. Second, there was often a requirement that algebra be taken as a prerequisite to courses involving computers. Third, when Hispanic students did have opportunities to interact with a computer, it was most often in drill-and-practice mode. Because most of the schools in the sample were low SES schools, they had few teachers who were trained to select software and to know how to use it. In addition, there were no after-school labs available due to concerns about the security of the equipment.

Barriers Due to Limited Proficiency in English

In some schools computers are used only for students in special programs, such as gifted programs or bilingual programs. Thus there are cases in which LEP students are the only students using computers. However, students who are LEP often receive less experience in using computers than their English-proficient peers. In two sites visited

by COMSIS staff (1984) students with low levels of English proficiency were given either no access or less access. Two reasons are generally offered for this state of affairs: (1) there is little software available in languages other than English, and (2) a minimum level of English proficiency is needed in order to utilize software written in English (COMSIS, 1984). Neither of these conditions needs to be a barrier.

The language a student speaks is either not an issue or is only a minor issue when the computer is used as a tool to carry out a task. Second language learning can be promoted through activities such a producing written texts using a word processing program, carrying out analyses using simple spread sheet programs, or producing greeting cards or graphics as part of a larger language-learning task. With a small degree of native language support such as a translation, an explanation, or a list of operating instructions, for example, provided in print form or verbally by a peer, teacher, or aide, the assumed barrier of lack of proficiency in a language can be removed.

Access at home

Tucker (in press) reports that most of the push to use computers in schools has come form suburban upper middle class parents, many of whom purchased home computers to prepare for using them in the workplace. Many limited English proficient students are from families who cannot afford a home computer. Thus home and community access is limited as well as school access.

SECTION III: USES OF COMPUTERS TO PROMOTE SECOND LANGUAGE ACQUISTION

Introduction

This section adresses ways in which computers are and can be used to promote second language acquisition. It begins with an introductory discussion of the benefits that are usually claimed to be derived from using computers. The body this section addresses major types of uses. This first is direct instruction in language, which is divided into two parts: (1) focuc on form, and (2) focus on message. The second use category is indirect language learning. In this category several projects are presented that have potential for application to L2 learning goals.

The Usual Benefits List

Computers are thought to have potential for enhancing instruction for language minority children for a number of reasons. The current shortage of qualified bilingual education and ESL teachers is likely to become more severe because the number of minority and LEP students is on the increase, while the federal government is not putting additional resources into bilingual teacher preparation. Computers used as tutors and aides have been viewed by some as one partial solution to the problem. While teachers' concerns that the computer might replace the teacher are not taken seriously by most observers, it has been proposed that more instructional interaction time can be provided with fewer human resources. The typical lists of the potential benefits of CAI for bilingual education (see Friedenburg, 1981, for example) also include motivation, a sense of control over the learning process, individualization (of pace, level, language, assignment), and the private nature of the interaction and feedback that is nonjudgmental. If one builds on research in L2 acquisition in bilingual and other programs, it will be possible to use computers in ways that have not yet been researched but that have great potential for promoting L2 learning at reasonable cost.

Categories of Uses

The ways in which computers can be used in relation to L2 acquisition can be categorized according the focus of the activity from the point of view of the student and the teacher. Uses that have as their primary goal the teaching of language can be referred to as direct instruction in language or CALL. Within CALL, lessons can be accomplished in which the learner's attention is focused primarily on form or in which the learner's attention is focused primarily on a message.

In the second broad category of uses one goal of the teacher is the learning of something other than language, while the learning of language is an additional goal. The focus of the student is primarily on the subject matter content or the functional task. When the student does focus on language explicity, it is for the purpose of accomplishing the task at hand.

Direct Instruction in Language (CALL)

Focus on Form

As discussed in the section on CALL software, the majority of the software currently in use focuses on vocabulary presented in limited contexts, the grammar of English, mechanics such as spelling, and usage problems of native English speakers. Consideration of several important issues should guide the development and use of this type of courseware for LEP students in elementary and secondary schools: (1) the ages at which students can benefit from such instruction, (2) the importance of the content for second language learning, (3) the proportion of second-language learning time that should be spent in this type of activity.

Age. Surprisingly, there is little research on the effects of the explicit teaching of the formal aspects of a second language to children of different ages. Current theory in second language acquisition suggests

that teaching grammar explicity to children is not as effective for overall L2 acquisition as creating environments in which they can acquire the L2 in a more natural manner -- through understanding and using the L2 for real purposes (Dulay, Burt & Krashen, 1982; Ellis, 1984a, 1984b; Krashen, 1982; De Avila, Cohen & Intili, 1982). The extent to which very young children will benefit from explicit instruction in the formal aspects of a second language is quite limited because, as Snow (1985) points out, their abilities for intentional second language learning are quite limited. They may lack the metalinguistic awareness to understand the structures being practiced in some of the current so-called ESL software. It is my suspicion, based on observation of young children working on form-based software, that they will often play the game of doing the exercises, memorize the correct answers, and pass the activity, while not having understood the concept they were dealing with. They will, therefore, not have gained new knowledge transfable to new language-use situations. In his research with older students, 11-15 year olds, Ellis (1984b) found that intensive ALM-type instruction in Wh interrogatives had no effect on the route of development for his subjects. He concludes that exposure, listening, and opportunities to negotiate a communicative task are important for the L2 development of students in this age group.

Importance of the form. For students who can profit from a focus on form, the importance of the content of drill and practice CALL activities currently being used with LEP students must be addressed. An example from observations might best elucidate this point. I observed a third grader in a bilingual program working on a unit from the Milliken Language Arts series. The unit included several items addressing the spellings of capitol vs. capital. Each example sentence was presented in isolation, out of any intesting context. It appeared that the third grader didn't really understand the aide's explanations about gathering money (capital) to start a business, nor the difference between the capital (city) and the capitol (building). There was no evidence that the child was not simply memorizing which sentences got the "o" and which sentences got the "a" so that she could pass the exercise. It is an empirical question whether such memorized items are spontaneously transfered to other contexts.

It is also doubtful that a third grader will encounter a situation calling for her to use capital (money) at this point in her academic and fiscal career. The content of this lesson was most likely trivial relative to what she really needs to succeed in school. Unfortunately the contents of standardized achievement measures often loom as important teaching goals, and so software is selected to match the content of the test.

Proportion of time for form-based CALL. The amount of time that can profitably be spent on form-based activities is highly controversial. Krashen and Terrell (1982) recommend that only about 20% of a course for older students be devoted to the explicit study of grammar rules. High quality form-based CALL courseware might profitably be used in this way, with individualization, for older students. For young children, language learning time should be spent in functional activities in which the focus is on the content of the communication.

Empirical question

Based on these considerations, it can be concluded that form-oriented CALL lessons should play no role in the L2 learning program of very young LEP students, and only a very limited role for older students. Research, similar to that conducted by Ellis (1984b) might focus on whether the target skills are actually learned from these drills, and if so whether they are transfered to use in other situations. Information produced for teachers on using computers to promote language learning should address these issues head on. Teachers need guidelines regarding how much and what kind of grammar software can be effectively used with students of different ages. They also need guidelines on how to relate such instruction to the rest of the second language learning plan to see if learning, and transfer of the learned information to other situations, is occuring.

Focus-on-the-Message CALL

Many recent and innovative software development efforts are focusing on this area (Higgins & Johns, 1984, Underwood, 1985). Several projects of this nature and guidelines for communicative CALL are discussed in

the section on software. What needs to be researched is what kind of learning is occurring and how it occurring. For example, research in this area might build on current interaction research (see Gass and Madden, 1985) to determine in what way user-computer interactivity results in negotiation and other processes believed to cause L2 acquisition.

Although communicative CALL software is a giant step forward from drill and practice software, the confines of the CALL lesson represent a fairly limited second language learning environment. Even in communicative CALL, the typical instructional discourse structure is often prevalent: the teacher or computer initiates a move (e.g."Where do you want to go?"), the student responds (e.g. "Up the cliff"), and the teacher/computer evaluates the response ("You can't go that way!"). Language learners need exposure to a rich variety of language used for many functions in many settings to acquire the L2 (Ellis, 1984a, Wong-Fillmore et al., 1985.) The use of the microcomputer as a tool to accomplish functional tasks has far greater potential for second language learning than traditional or even communicative CALL lessons.

Indirect Instruction in Language

Recent research in second language development has focused not only on the ways in which language learning occurs in task-based conversational exchanges in an ESL class (Long & Porter, 1985), but also on how language can be learned within the context of instruction in academic content classes (Wong Fillmore et al., 1985; Long, 1985; Miller, 1982; Swain, 1984). Researchers and program designers have stressed the importance of planning second language learning opportunities on a whole-day basis, within the context of bilingual education programs if possible, and integrating second language learning opportunities into content instruction and the general social structure of the classroom (August, 1982; Johnson, 1983, 1985; Milk, in press; Wong-Fillmore, 1985; Enright, 1985).

De Avila, Cohen, and Intili (1981) conducted an extensive study of the implementation of a Spanish/English bilingual math and science

curriculum for elementary students. They found that when students were grouped heterogeneously with regard to language proficiency and academic achievement level, worked on motivating math and science tasks, and were allowed to do their work in either language, excellent results were obtained on standardized achievement tests in English. English was learned as a "by-product" of concentrating on interesting whole tasks in a non-remedial manner. Carefully planned uses of computers can contribute to learning English as a by-product when focusing on tasks related to both social and academic success in school.

Some Exemplary Computer Projects

Some of the most creative and potentially useful projects applicable to promoting L2 learning while using computers are projects that are not addressing issues of L2 learning. Nevertheless they embody features that are consistent with current theories of second language acquisition and current ideas about setting up L2 programs within a whole-day design framework (Johnson, 1985).

Functional learning environments. A cross-disciplinary team of researchers at the University of California, San Diego, with funding from NIE and other sources, has implemented and conducted as series of studies of programs using computers as tools in several elementary classrooms. The projects have focused on language arts and math instruction for native speakers of English as well as some LEP students and have incorporated microcomputers primarily as tools for a range of applications that reflect their use in the work place and society (Mehan, Moll & Riel, 1985).

Mehan

Several prinicpals guide the work. Functional learning environments are created in which students work with others on whole activites rather than on alone on isolated subtasks. For example, students learn computer machine operations as they are embedded in academic tasks. Students are provided with "dynamic support," which refers to "the process of systematically decreasing amounts of assistance provided to novices as they progress

in expertise and gradually assume parts of the task initially accomplished by an expert" (Mehan et al., 1985, p.13). The amount of support is gradually reduced as children learn how to accomplish a task. In a classroom containing LEP Spanish-speaking children the LEP children performed the same academically challenging tasks as all other students and were given the support they needed to accomplish tasks. Rather than reducing intellectual demands the assumption was made that LEP students could perform the same tasks (Moll & Diaz, 1984). Support took the form of assistance from other bilingual peers or adults in the classroom and occasionally from Spanish or bilingual software. Any work on English skills or computer skills was subordinated to the higher goal of the academic task.

Monitoring of the introduction and use of microcomputers in several classrooms revealed that while teachers did not change their practices for organizing instruction, they did pair students for computer work, which added a new participation structure to the class. Students assisted each other in completing tasks and worked in a cooperative manner.

The writing programs in several classrooms, grades 3-6, was studied with teachers and researchers collaborating. The philosophy of teachers involved in this study was that writing should be taught as it is used in the real world--for communicative purposes. The overall philosophy of computer use was the notion of using computers as tools, and in the composition portion of the study, best results in student writing were achieved in classrooms where the computer was smoothly integrated into already strong and pedagogically sound writing curricula.

Students in the classrooms studied were evaluated by writing both on and off the computer. The type of writing done exclusively on computer was journalistic and communicative - the production of the "Computer Chronicles Newswire," an elementary school newsletter containing articles from local schools, and through disk exchange, from schools in other states. The number of computers in the classrooms was, as might be expected, limited, so children wrote in pairs to produce their news stories. In most cases, students' writing increased in length over the year, and

slightly in quality, and researchers concluded that while it was difficult to say how much of the improvement, if any, could be attributed to the computer alone, the results suggest that the functional writing environments that they created using computers affected the length and quality of students' writing (Mehan, Moll, & Riel, 1985). The study demonstrated that computers, when used in a pedagogically sound educational atmosphere, prove a useful resource and a feasible medium for writing.

Higher Order Thinking Skills (HOTS). A Chapter I project directed by Pogrow (1985a, 1985b) also has potential for use with language minority students who are acquiring English. The project, funded through the Secretary's Discretionary Fund, and selected as outstanding, uses computers within a curriculum designed to improved higher order thinking skills in students who are not achieving at acceptable levels. Pogrow is developing a two-year curriculum covering several curricular areas and based on the assumption that educators tend to underestimate the intellectual potential of Chapter I students. Basic skills are not viewed as prerequisite for successfully engaging in higher order thinking. Students are involved in formulating hypotheses and strategies for solving problems, given feedback, and then asked to apply their knowledge to other related situations. Goals are to improve analytical thought and confidence in the ability to solve open-ended problems. Social competence and basic skills are the expected by-products.

Evaluation results, while limited at present, show gains in reading scores, in several measures of higher order thinking skills, and 50% more friends for the HOTS students than for similar students in the control schools, as measured (posttest only) by a sociometric instrument. Pogrow attributes the social differences to two causes: (1) pair and group work that created opportunities for social interaction in the lab, (2) computer expert days in which project students invited "non-compensatory" students into the lab and served as expert by teaching their peers, and (3) self-confidence in their cognitive competence. Because self-confidence and social interaction are both important variables in second language acquisition, these findings are important for language minority students.

FLE's for teachers and students. Researchers at the Center for Children and Technology at the Bank Street College of Education have also studied uses of microcomputers as a tool in functional learning environments (FLE's) in which learning activities are functional both from the teacher's point of view and the child's point of view (Newman, 1985). In one such project, students use a variety of media (the computer included) to first acquire information, then use this information for problem solving. For example, students learn navigational and geometry-related skills to plot a course to rescue a distressed ship. They also attempt to answer questions about whales by creating a data base, demonstrating the "variety of resources -- such as textbooks, encyclopedias, and films - that are available in our culture for obtaining the facts..." (Newman, 1985, p.51). These kinds of activities at once engage student interest and encourage creativity in problem solving.

Culturally appropriate lessons. Interest and engagement can be enhanced by making materials culturally relevant to students. A project conducted in New Mexico for bilingual children on the Acoma Reservation provides one example of how cultural considerations can be taken into account in designing microcomputer learning activities. The tradition of oral storytelling is a means of transmitting information familiar to and comfortable for Acoma children (Hakes, 1981). Storytelling by cartoon characters on a microcomputer synchronized with audio tapes was the technique used to teach fifth graders math and science concepts related to energy. The stories and accompanying instructional games and activities were all set in contexts related to the everyday activities of the students and therefore familiar to them. Hakes' report to NIE and NSF indicates a successful implementation of the six-week curriculum. Reported outcomes were increased involvement in learning and increased peer teaching.

Basis for Model Development

We have asserted above that using computers as tools to accomplish functional tasks is the most promising direction for future development. The programs discussed above share a set of common features, features

consistent with aspects of effective second-language-learning environments.

The projects at UCSD, Bank Street, and the Acoma Reservation, as well as Pogrow's HOTS project, embody some parallel assumptions and approaches. All take a non-remedial approach to teaching by allowing students to use and develop their intellectual skills to accomplish whole tasks and solve problems. The mastery of "basic skills" is embedded in the context of whole tasks. These tasks are functional from the point of view of both teacher and student. For the student, they are interesting and meaningful, and for the teacher they create a context in which instructional objectives are met. The timely provision of appropriate support (text generation software, teachers, peer collaboration, L1 explanations, etc.) leads to successful experiences and confidence on the part of students.

These features have much in common with conditions necessary for successful second language learning. Research by De Avila, Cohen, and Intili (1981) demonstrated that functional math and science learning environments produced gains in both achievement and English. The computer could easily be incorporated as a tool into such a curriculum. The fundamental principle that "development always occurs within the framework of the whole" (Cole & Griffin, 1983) is parallel to the concept in second language acquisition that development arises out of participation in meaningful, negotiated conversation. Current second language acquisition theory posits that language is best acquired through use for real purposes rather than a focus on isolated forms out of context.

Obviously, curricula developed for native English speakers cannot be transferred to the second language classroom some modification. Modification should involve not the intellectual challenges of tasks but the amount and nature of support provided to students so that they can participate in and accomplish the tasks. Support for LEP children can take several forms in addition to that provided to the native speaker of English. Linguistic support in the L1 can allow students access to tasks that can then later be performed in English. When working in English,

non-linguistic support must be provided so that students can figure out meanings. Linguistic support in the L2 the form of expansions, repetition, paraphrasing, and lesson scripts will contribute to comprehension as well as to the larger objective of performing a given task (Wong-Fillmore et al., 1985). Social support can be provided by pairing and grouping students. The computer classroom must be organized in ways that research has shown to be conducive to second language learning. Learning situations involving the computer should provide input that is comprehensible and plentiful opportunities for interaction and discussion.

In this model of computer use for second language learning the teacher cannot send students off to be subjected to drill and practice. Newman (1985, p.56) states that "a teacher must build bridges between the tool, the school task, the thinking skills, and their functional significance for the culture beyond the classroom." For LEP students the teacher must also take an active role in planning the opportunities for students to obtain the kind of input and interaction they need for second language learning.

Composition with Microcomputers

The use of computers in the process of writing and composing is one of the most widely recommended tool uses at the present time. Word processing software programs are some of the biggest sellers to educational markets (Tucker, 1985), and their use in schools with students is following in parallel fashion their widespread use in business and industry. Software programs that assist in the process of writing are also in use and under study, primarily with native speakers of English, and have potential for LEP students as well. This section addresses some current writing programs for native speakers of English students, students of heritage languages, and LEP students.

Composition Programs for Native Speakers of English

There has been some very interesting work done using computers with younger students of writing, primarily with non-LEP students, however. Daiute and her colleagues, for example, have examined uses of computers in writing for monolingual English speakers. Daiute likens the computer to a "drudge" - a classroom tool for young writers that can eliminate much of the unpleasant physical effort of writing - particularly recopying for young writers. She also points out that word processing, by narrowing the time gap between thought and its transcription, can relieve the overload on short term memory, a special problem for young children with developing cognitive capacities (Daiute, 1983).

In a Harvard project, Daiute and her colleagues developed "Catch" - a revision program for young writers that was tested with nine- to twelve-year-olds. Catch is a simple revision program but similar in general function to the one described above. Students are asked to reflect on whether the meaning of paragraphs is clear, for instance, and the program provides simple information on sentence length and vague language. Daiute reports that children seem to learn word processing more easily than adults do, and also that they prefer writing on a computer to writing with a pen. Children in her study revised more on computer than they did when writing the traditional way (Daiute, 1984). She found, however that, for junior high students, it takes more than one school year to produce the quantity and quality of writing that they could produce with a pen (Daiute & Kruidenier, 1984 and Daiute & Kruidenier, in press, cited in Perkins, 1985).

Another major program developed for native English speakers but being used with LEP students is IBM's Writing to Read. The use of the program has been evaluated with kindergarten and first grade children over a 2-year period in 21 sites (Murphy & Appel, 1984, cited in Lieberman, 1985; Tucker, 1985). It has been implementated recently with LEP students in bilingual program settings (in Kingsville, Texas, for example). Because it was designed for native English speakers and because of its phonics

emphasis, it's appropriateness for LEP students is controversial and needs to be carefully investigated. If it is found that some of the integrative and organizational features are applicable to second language learning, suggestions might be made to IBM regarding ways of adapting it to meet the needs of LEP students acquiring English.

Heritage Language Writing

Cummins, at the Ontario Institute for Studies in Education, is currently designing a heritage-language project to promote the teaching of languages other than French and English. He plans to set up an international writing network to provide a means and purpose for students to engage in process writing. They will produce news stories and accompanying art work on computers, and Chinese students in Toronto, for example, will communicate and exchange stories by electronic mail with Chinese students in Boston or China. The students include those with no knowledge of the heritage language as well as those with limited knowledge, from grandparents, for example. Goals are to improve students' reading and writing skills in the heritage language, their high level cognitive skills, their knowledge of computer applications, and their cultural knowledge. The philosophy behind the project is that students can learn through an approach that provides enrichment rather than remediation. In a pilot project he collaborated with 25 Spanish and Portuguese heritage-language teachers who engaged their students in process writing. He states that the program worked well for students who had, for example, some receptive ability in the language but little productive ability (J. Cummins, pc, Oct. 9, 1985). Because his work deals directly with second language acquisition, it should provide some very useful information regarding theoretically and pedagogically sound uses of technology in promoting the acquisition of ESL.

Writing Projects for LEP Students

Word processing is just beginning to be used for writing for LEP students and is recommended by Underwood (1984) as one of the best language-

related uses of computers. The COMSIS study (COMSIS, 1984), while fairly recent, reports very little use of word processing among the nine Title VII sites visited. The researchers reported that one site used word processing for writing activities in all content and skill areas and, in addition, implemented a "very innovative" use of word processing - the production of a weekly school newsletter.

In a Title VII demonstration project in Tempe Elementary School District in Arizona, Maez and his colleagues have implementad individualized computer summer programs for low SES LEP third, fourth, and fifth grade students. The curriculum included language arts, math, and computer literacy. After evaluating over a dozen word processing programs (and over 300 programs in all), they selected Magic Slate (by Sunburst) for use by the students. Students wrote daily journal entries, stored the text on a diskette, and teachers responded daily to each student. While data have not yet been analyzed, Maez observed increased quantity and quality in writing and more use of peer editing (L. Maez, pc, Sept. 11, 1985). A process evaluation of the program indicated successful implementation of the summer programs (Casas & Furlong, 1985), and the staff are currently working to institutionalize the project. Teacher training materials were developed (Maez, 1985), several teachers were well trained, and some have already incorporated a computer center into their classrooms.

Both text generation programs and word processing programs can be used profitably with LEP students in the acquisition of English. Text generation programs of the type developed for the UCSD projects could be adapted for use with LEP students, either by adapting the software or by increasing the nature and amount of support provided to the LEP student.

There is at present a schism between accepted composition theory for native speakers (which de-emphasizes grammar instruction) and for ESL students (Zamel, 1984) and the existing ESL "composition" software, which seems to be primarily grammar-based. However, as ESL composition theory and practice move toward more of a process orientation, the computer

will become a valuable aid for LEP writers at every level.

The production of newsletters is becoming a popular kind of writing activity, possibly because it is functional (occurs in real life), allows for collaboration in pairs or small groups, provides an audience for what is written, provides a real purpose for making revisions and editing surface features. The articles also make interesting, motivating reading for the recipients. Because such principles are consistent with what makes a sound second language activity, research and information on how to use this type of approach with LEP students would be useful.

The features of software that facilitate the writing process of native speakers can like serve the ESL writer - ease of writing, revision, and even some stylistic analysis. In fact, if computers were smoothly integrated into existing ESL composition curricula (as they were in the UCSD project), they could eliminate much of the agony now faced by ESL writers. Some feel there may be a special danger for ESL students to rely too heavily on computer-assisted revision since many surface errors that might other wise go unnoticed by the writer can be neatly and pleasantly corrected by the computer, resulting in a finished product illustrative of a false proficiency. The other view is that the computer "frees the students to do the right thing" (Perkins, 1985, p. 12) and viewing one's own ideas expressed in the right forms can contribute to learning.

Still, the conventional wisdom tells us that "writers learn to write by writing," and several studies demonstrate that young and older writers alike write more on a word processor than by other means. Even if we lack conclusive evidence that writing quality is improved by using a word processor, we can conclude that the mere volume of writing and its ease and novelty, makes the computer a valuable tool in the ESL classroom. Also, writing is such a central task (Perkins, 1985) and word processing is so common in the workplace, that it is a valuable skill in itself, as can be viewed as an alternative to a pencil. The major difference is, of course, cost.

SECTION IV: SOFTWARE DEVELOPMENT, EVALUATION, AND DISSEMINATION

Introduction

This section addresses issues in the development, evaluation, and dissemination of software. The first section points out the need to take advantage of what has been learned from CALL software development on mainframe and minicomputers when embarking on projects for microcomputers. Selected software packages and software development projects are discussed in two parts. First software designed specifically for ESL is dicussed focussing primarily on good projects but also pointing out some persistent problems. Secondly, software designed for purposes other than ESL is discussed, as well as the features these programs embody that make their use feasible for second language learning. The following sections address guidelines for developing ESL software, and sources of software development, review, and dissemination.

Who is developing the best CALL software and what makes it good? There are no easy answers to these questions. Establishing guidelines for assessing the adequacy of CALL software is complex because of continually changing ideas about what and how students need to learn from computers, about computers, and with computers.

Mainframe ESL Software: The Edsel of CALL?

Efforts in the development of ESL courseware can be categorized into mainframe and microcomputer efforts (Wyatt, 1984), with most current development for microcomputers. The major mainframe developments have been lessons for the PLATO system (Chapelle & Jamieson, 1984) and the ESL program developed by the Computer Curriculum Corporation of California in Palo Alto. While the PLATO lessons are about ten years old, and while they were not designed specifically for ESL students, some experts (Dunkel, pc, July 18, 1985; Chapelle, pc, July 28, 1985; Jamieson, pc, Sept. 17, 1985) feel that they are still among the best existing lessons in advanced grammar for adolescent and adult students. The authoring language allows

for the identification of mispellings, for example. Nevertheless, they are viewed as the Edsel of CALL (Dunkel, pc, July 18, 1985) and their use has diminished in recent years. This is clearly due, in part, to the predominance of microcomputers; PLATO lessons are not available in a cost effective manner for micros. It may be due in part to both the desire to innovate and try new curricula and the current deemphasis on formal lessons in grammar. Nevertheless, several observers have noted that developers of CALL software for microcomputers are making the same mistakes that were made years ago in developing PLATO lessons. Thus any software development efforts should build on what has been learned by those experienced in the PLATO efforts.

The lessons developed by the Computer Curriculum Corporation have a unique advantage because they consititute an entire curriculum. A logistical disadvantage is that they will not run on the commonly used microcomputers. Interviewees described these lessons as out of line with current views regarding language teaching and learning (Stevens, pc, Aug.12, 1985). Nevertheless, because the curriculum is a complete one, it is used by a number of schools, primarily to supplement other ESL curricula.

Selected Software and Development Projects for L2 Instruction

Most CALL software teaches grammar and vocabulary. Other than these two areas, a great deal of potential for CALL lessons lies in the areas of reading comprehension, listening comprehension, and writing. A small sample of model lessons and lessons under development is reviewed in this section. Most were recommended by interviewees and others were reviewed.

Audio-enhanced comprehension lessons. Dunkel, at Pennsylvania State University, compares CALL lessons without an audio component to the silent movies. She is developing a set of audio-enhanced lessons called "Listening Plus" to accompany a text entitled Intermediate Listening Comprehension (in press, Newbury House). The lessons employ a random-access audio

screen to access the pronunciation or the translation of any word (Demers, pc, July 29, 1985). This project builds on a great deal of high quality previous work by the authors that incorporates sound principles of language teaching.

Videodisc trips. One of the best known CALL videodisc lessons is the "Montevidicso" Spanish language project developed at Brigham Young University (Schneider & Bennion, 1984). The student takes an imaginary trip to a town in northern Mexico and converses with the Mexican townspeople. For example, the student may visit a pharmacy and must decide what to buy. When the Mexicans ask questions in Spanish, the image freezes to give the student time to respond. Options for responses appear on the screen. The student chooses the desired response, speaks into the microphone, the response is recorded, and the program continues, branching according to the student's response. The course of the trip depends on the student's choices. This is "the ultimate in comprehensible input" (Underwood, 1984) and is humorous as well. One problem is that instructor must later evaluate the student's recorded utterances. This lesson is highly regarded and, although extremely expensive to produce, provides an excellent model for other developers.

Mystery House. This program (Sierra On-line Publications) has been reviewed in the TESOL Newsletter by Balch. It is an adventure game in which learners learn to spell household items ("candle," for example). Interviewees who have used it observed that it is an effective communication device; students become excited and talk a great deal to each other and to the teacher.

Grammar Mastery. This program, a discrete skills program by Regents ALA, was recommended by some interviewees for its completeness, although others felt that it is not as good as PLATO grammar lessons. The series consists of 18 diskettes addressing six grammatical concepts at three level of proficiency.

Composition software for ESL. Software created specifically for ESL composition is primarily intended to improve students' writing by giving them control over the surface features of English. Dalgish (1985), at the City University of New York, has created unique grammar-based computer modules for an ESL writing program. The modules are formulated on the basis of computer assisted error analysis. A mainframe computer has been used to determine types of grammar errors common to different L1 groups. For example, subject/verb agreement problems differ for Chinese and Russian students. Dalgish and his colleagues have then used these data to generate individualized grammar instruction modules that have the capability to randomly generate sentences and also branch to particularly troublesome sentence structures according to the user's first language. While most software requires students to repeat an example several times, the random generation of sentences provides variety and some humor (Dalgish, pc, Aug. 29, 1985).

Southwell of York College describes software developed to serve "students whose writing exhibits severe problems of correctness and clarity," usually ESL students (Southwell, 1984). His COMP-LAB Writing Modules offer instruction in five grammatical features that he has deemed most problematic for basic writing students (noun plurals, verbs and subjects, verb agreement, past tense verb forms, and copulative verbs). These modules are "incremental" such that each successive module depends on previously completed modules to continue instruction. Grammar points are continually reviewed as new material is presented in small amounts. The target grammatical features are sometimes presented in the context of sentences or short paragraphs. Southwell cites the standard advantages claimed for CAI for this type of instruction: individualization, special graphic capabilities for highlighting important material, the autotutorial nature of the COMP-LAB modules (which put responsibility for learning on the student), and finally the novelty and practicality of using the computer.

Unfortunately, samples of Southwell's COMP-LAB modules show that they exhibit many of the disadvantages and limitations common to unimaginative

drill and practice programs based on audiolingual second-language teaching methodology. For example, the software requires a great deal of metalinguistic knowledge (e.g., "You need to rewrite this sentence with a new subject. Decide whether the new subject is singular or plural; then use the appropriate form of the verb" (p. 102)). Also, the software has technologically unnecessary insistence on absolute correctness in replies. For example, when asked to generate a plural sentence from a singular one, the user in the sample writes ">we both wants a new car." Before the computer responds to the subject/verb argeement error, it snaps "Remember, sentences begin with capital letters. Try again" (p. 100). In another instance, the module asks the user to identify a noun as singular or plural; when the answer is ">pluarl" (and the noun was singular), the computer impatiently says "please check your spelling and try again." (p. 98). When the hapless student finally spells "plural" correctly, he or she is informed that it's the wrong answer anyway! Despite the limitations of Southwell's COMP-LAB, it, along with Dalgish's work, are examples of the better software being developed to assist in the grammatical aspects of ESL writing.

Selected Software Designed for Native Speakers of English

Zork III. This popular game by Infocom was recommended as a good example of what the current technology is capable of accomplishing. Computer Entertainment magazine reports that it is representative of the state of the art in game parsers (Addams, 1985). The game involves reading text to go on an adventure in an imaginary land. The user makes choices about where to go and what items to pick up and tells the computer what to do by typing in simple instructions. The user must draw an extensive map to analyze the geographical features of the area. While the parser produces far from intelligent, human-like responses ("I don't know that word"), simplified versions of this type of game with appropriate support in the form of an L1 dictionary, help in guessing from context, or peers, could be appropriate for language learning.

Sentence Combining. This program, by Milliken, is very widely used in bilingual programs (COMSIS, 1984) and was recommended for use with high school students. It involves the imaginative use of cursors as pencils and erasers which students control to perform traditional sentence combining drills. While it employs pleasing graphics, has many lessons, and high school students enjoy it, it is not appropriate for very young children. Its focus on form and the degree of metalinguistic awareness that it requires make it doubtful that very young children will profit from the exercises. In addition, Spanish speakers already possess most of the target structures in their L1.

Composition software for native speakers: Process. The state of the art in computer assisted composition instruction for native speakers is far more advanced and different in focus from the grammar modules currently in use for ESL composition students. The software available for native English speaking writers is based on an entirely differnt approach to composition, the process approach. The process approach (Lindeman, 1982; Zamel, 1982) views writing as a cyclical process of prewriting (generating ideas, brainstroming, freewriting), writing (drafting, getting ideas into prose), and rewriting. The rewriting stage consists of two parts, revising (reviewing ideas) and editing (checking form). Composing is part of a thinking process...an act of clarifying thought by putting it on paper, and what distinguishes the process approach is revision, the crucial rethinking process that is so important to good writing. The process approach seeks to break down composition into smaller, more manageable stages, so that students can compose more freely without worrying about surface concerns. Many novice writers (and ESL writers) are virtually paralyzed by a fear of surface errors, so that content in writing is shortchanged over concern for form.

The computer, with its capabilities for easy revision and quick data entry, is a natural medium for emphasizing a process approach in composing. At the earliest stages of writing, computer software is now available to help students generate ideas and clarify thinking. These sorts of heuristic programs aren't intelligent; that is, they interact

with users merely by keying in on certain words in student responses and creating questions about them. Still, many writers need help in generating new material for writing that will be later refined, and the computer can provide patient, non-judgemental help at this stage of writing. Such programs include TOPOI, SEEN, and WANDAH. Work done by Mehan, Riel, Miller-Souviney, Souviney, Whooley, and Liner (for example Mehan & Souviney, in press), describe software and its use for elementary and junior high school students. Much of this work is applicable for use with LEP students.

The speed and ease of composing on the computer makes it a valuable tool in the writing stage. The speed and touch of the computer keyboard narrows the gap between the speed of the flow of the writer's thoughts and the physical limitations of getting that thought in visible form. Wordprocessing programs such as Magic Slate, Bank Street Writer, Apple Writer, The Writer's Assistant, Homeword, and Wordstar are widely used.

Once a draft is completed, computers can assist in the process of "rethinking" in writing. Although no computer can provide the qualitative feedback of an instructor during revision, there are programs (WANDAH, Wordsworth II) which, by identifying topic sentences in each paragraph of a draft, can provide a sort of outline of the draft, a short, clear summary of the logical progression of the composition. The computer can't comment on the logic, of course, but it is to be hoped that beginning writers, seeing their work in this abbreviated form, may be able to make their own judgments on its logical strengths, gaps, and weaknesses.

The interactive capabilities of a networked computer system offer more help at the revising stage - other students can read and comment on peers' writing, offering fresh insights and comments (politely displayed in windows on the screens of text) that provide qualitative feedback that is in language comprehensible to the writer. Teachers and students can engage in ongoing interactive writing of journals or other types of messages.

The capabilities of computer software for editing are varied and great. Even the most primitive software has the ability to check spelling, keep a dictionary (and highlight words that do not appear in it), detecting not only spelling errors but typographical errors as well. UNIX, a program developed by Bell Labs in Denver, and used experimentally by the University of Arizona last spring, has capabilities far beyond this. The program is being constantly improved and enlarged, but among its current capabilities: (1) DICTION highlights "misused, wordy, sexist, inflated" words and phrases (about 500 possible) and SUGGEST offers replacements for them, (2) FINDBE detects and capitalizes all uses of the copula in a text (often considered a possible sign of weak and amateurish writing), (3) CHECK lists commonly confused homophones and word pairs, highlights them, and gives brief explanations of usage should students need the help, (4) GRAMMAR points out split infinitives and misuses of "a" and "an," (5) STYLE summarizes information about sentence length, opening words in sentences, types of sentences (compound, complex, etc.), even counts in grammatical word classes (McGinnis, 1985; Kiefer & Smith, 1984). Other editing programs include Writer's Workbench, EPISTLE (IBM), and HOMER (Scribner's). Most of these are too elaborate, however, for most ESL applications. Work needs to be done to identify simple programs of this type and to either modify them or suggest how they can be modified, and to describe ways that they can be used appropriately for ESL learners of various levels.

Guidelines for the Development of CALL Courseware

Interviewees expressed the opinion that it is difficult to develop guidelines for the creation of quality software because of rapid changes both in theories of second language learning and in technology. The development of such guidelines is also problematic because of continually changing ideas about what and how students need to learn *from* computers, what they need to learn *about* computers, and how they can learn *with* computers.

CALL guidelines for children and older students. A number of TESOL CALL experts agreed that the best sources of guidelines are the books on CALL written by Underwood (1984) and by Higgins and Johns (1984). Underwood, for example, provides in his Chapter 6 a list of 13 premises for communicative CALL based on current theories of language acquisition (primarily Krashen, 1982). The premises address only CALL courseware for older learners, however.

There is little published information regarding the development of ESL software for LEP students, especially children. Perez (1984) has written an article addressing this issue. She provides a brief review of literature in second language acquisition and general CAI. She then sets forth some broad and sound principals to guide ESL/CAI software development. These include: (1) goals should be communicative competence and functional literacy related to academic concerns, (2) practice of the L2 should be holistic, in context, creative, and multisensory, (3) feedback should be provided in response to content and meaning and only secondarily and selectively to form; (4) lessons should be student-centered, motivating, and draw on students' background. Perez also wisely states that CAI lessons should be integrated into a natural language-learning environment involving active, creative interaction with peers and adults.

Cultural and bias issues. In general, guidelines for developing culturally appropriate, nonsexist, nonbiased instructional materials of any type can be applied to the development of courseware intended

for second language learning. There is very little written on cultural considerations in developing software for bilingual or language minority students. The project conducted in New Mexico for bilingual children on the Acoma reservation provides one example of how cultural considerations can be taken into account. Any set of guidelines for developing software should address the culture of the intended audience.

Software Development Efforts

Who is producing the software? There are many individual development efforts underway, primarily by people creating isolated lessons (as opposed to a complete set of lessons, such as the PLATO series) and working in a vacuum (Chapelle, pc, July 28, 1985). Chapelle will develop software with funding from Digital at Iowa State University at Ames. For the Brittish Council, Higgins has developed communicative coursware for microcomputers (described in Higgins & Johns, 1984). This software, although not highly sophisticated in answer judging (it uses pattern matching), is considered some of the best work available. The art of answer judging, however, is being refined at the University of Iowa, Iowa City, by Jim Pousack, who is known for developing an authoring system named DASHER for creating German lessons.

The role of publishers. Publishers of ESL materials are currently in the process of exploring how they might profitably enter the CALL market. Until recently, most did not see a guaranteed market large enough to ensure the profitability of their entrance into it. A number of interviewees have approached publishers about either publishing their software or funding the development of new work. Publishers have been reluctant. Reasons offered by interviewees included the following: (1) publishers are only interested in "flashy" software; (2) most are hesitant to enter the market. A strong precedent of success may need to be established before many publishers contribute to the high cost of development.

Regents/ALA is the major ESL publisher developing fairly high quality material including games and other pedagogically sound as well as motivating

courseware (Stevens, pc, Aug. 12, 1985). While Regents does have people with CALL expertise on staff, their major pool of expertise comes from the American Language Academy in Rockville, MD. Interviewees reported that other publishers are watching the Regents/ALA effort to judge its success before entering the market. Longman, another ESL publisher, is about to publish a package for ESL entitled QUARTEX. Wida Software in London publishes much good quality software. Holt Reinhart has published Chris Jones' "Story Board" and "Cloze Master", which were originally developed for Wida in England. This work in considered progressive by some and criticized by others. Software is also being developed by the military establishment, non-ESL publishers, various funded projects, the Minnesota Educational Computing Consortium, Conduit at the University of Iowa, and others.

Software Review

Educators working with LEP students in elementary and secondary schools have few places to turn to obtain reliable information on both the quality of ESL software and how to use it within an instructional program. The is no one authoritative source of information on ESL software for LEP students. Most sourcebooks supply only catalog-type information and published reviews of specific pieces of software sometimes indicate that more importance has been placed on the technical than on the pedagogical qualities of the software.

Sources of information for review. The COMSIS report (1984) on uses of technology in Title VII-funded bilingual programs found that project personnel used four methods to identify software: (1) referrals by other computer users, (2) visits to computer stores, (3) periodicals (generally educational periodicals), and (4) advertising from educational software publishers. Project personnel found that 70 to 80% of the courseware they reviewed was unsuitable for their needs. Due to a lack of authoritative information about what good software is available, many educators are wasting time evaluating software that many others have also evaluated and rejected. While what is quality to one person is mediocre or even

poor to another, there should be some generally agreed upon criteria that could screen out the worst of the programs. Some programs being promoted at bilingual education conferences address such unimportant skills in such a pedagogically unsound manner that they may be hazardous to students. This new wave of bad ESL curricula requires the same kind of warning that Troike issued in 1976: "ESL may be hazardous to children," when it consists of practices not based on the best available theory Troike, 1976).

Respondents in the COMSIS study stressed the need for a method of obtaining information on courseware appropriate for use in bilingual and ESL environments. Project personnel suggested that OBEMLA establish an electronic bulletin board allowing projects with computers to communicate by phone to an OBEMLA computer so that information regarding software could be exchanged among users. Large urban areas often have computer resource centers or softswaps that are not available in less populated areas.

Two national organizations have taken a leadership role in supplying catalog information on software for language minority students. The National Clearinghouse on Bilingual Education has produced a Guide to Microcomputer Courseware for Bilingual Education (Sauve, 1985) which provides basic descriptive information on over 400 pieces of courseware. Because no evaluative information has been supplied by NCBE, the catalog can be useful for only two major purposes. First, it contains a title/producer index, a content area/hardware index, and a language/grade level index that allow users to locate the producer of courseware for which they have incomplete information. Secondly, the catalog supplies references to published reviews of courseware when such reviews exist. What users need, however, is reviews based on a published set of criteria.

The former National Center for Bilingual Research conducted a major activity in this field, the production of a book entitled Microcomputers in Bilingual and Foreign Language Instruction: A Guide and Bibliography (Hertz & Jacobs, 1983). It contains an introductory 40 pages of narrative

addressing topics such as CAI, language learning, teachers as programmers, language instruction, (four pages covering vocabulary, reading, listening comprehension, composition), and hardware. A series of brief appendices address: funding CAI, courses and programs in computing, a bibliography of articles, and names and addresses of users and professional organizations. The largest section provides a list of courseware for ESL, BE, and FL programs. It is not as complete or extensive as that of the Clearinghouse, however, and is of limited value to educators.

While these types of directories are somewhat useful for the purposes stated above, they tend to overwhelm the educator with information that is not very helpful for selection and will be quickly outdated. A similar phenomenon occurred when language proficiency tests first came into widespread use. Thick catalogues appeared which were useless in helping to make choices. Gradually research firms, states, and publishers all played a role in narrowing down the field and eliminating the worst tests. This needs to be done on a continual basis for ESL-related software. Another major problem with these catalogues is that they apparently do not include courseware designed for standard English language arts but widely used for ESL. For example the Milliken Sentence Combining program, of debatable value, but widely used for ESL (COMSIS, 1984) is not listed in either catalog.

Many interviewees look to the professional literature for reviews of software. The publications most often mentioned were for ESL were: CALICO Journal, the CALL-IS Newsletter, CALL Digest. General publications are Creative Computing (lots of reviews), Electronic Learning (the best for education oriented reviews), A+ for Apple, the counterpart magazine for IBM, Personal Computing, and The Computing Teacher (Stevens, pc, Aug. 12, 1985). Most interviewees agreed that there is no authoritative source for reviews of software for LEP students, especially children.

The project at IDRA, funded by the Carnegie Corporation, is filling this gap to some extent. IDRA has developed a set of criteria for evaluating ESL software, based on the principles defined above, and has applied

the criteria to most of the software developed specifically for ESL in grades K-12. They plan to publish a software guide that displays evaluative information organized in chart form. It will address software in three categories: English language (language arts, language development, reading), Spanish language, and ESL. Information will be disseminated through the IDRA Newsletter (Perez, pc, Sept. 22, 1985). Such information is unavailable at the present time and much in need. Depending on the quality and usefulness of the guide, consideration should be given to disseminating it through the National Clearinghouse for Bilingual Education and/or other networks, and supporting the project on an on-going basis.

Participants in the review process. Survey work has shown that there is generally one leading computer-using teacher in a school or district who guides the uses of computers with students and the software selection process. This issue was addressed for bilingual programs by the COMSIS study (1984). COMSIS found that teachers were not always involved in screening software. In sites where teachers were involved in the process, however, teachers "seemed to have a better understanding of the role coumputers could play in education" (COMSIS, 1984, p. 57). The importance of the involvement of teachers in screening and selecting software was emphasized by several interviewees (L.V. Maez, for example, pc. July 25, 1985).

Dissemination of Information and Software

Within the bilingual education networks, the major disseminators of information on uses of computers with LEP students are the National Clearinghouse for Bilingual Education, a newly formed organization, Bilingual Educators for Computer Assistance (BECA) located at Texas A & I University, and the Multifunctional Support Service Centers funded through Title VII. The Clearinghouse has a file of articles on many computer topics that it distributes in response to requests. BECA publishes a newsletter, Micronica, that it sends to members and also provides consulting services.

Within the TESOL networks, the major sources of information are

the special interest section network and newsletter, CALL-IS Newsletter, and the TESOL regional and national conferences. The newletter contains software reviews and book reviews, articles, and general announcements. Because Apples, IBMs, and Commodores are the major types of computers in use, the CALL-IS has a user group chair for each as well as a VESL and writing chair. They serve as contact persons and may provide software exchange services. Ohio Universaity will initiate a clearninghouse for public domain adult ESL software and plans to distribute a catalog newsletter.

The major means for the dissemination of software currently in use for ESL are: commercial marketing, clearinghouses such as CONDUIT and MEEC, state sponsored units or software consortia, county offices of education in large states, the CALICO data base (deals with all foreign languages), RICE (Resources in Compensatory Education) data bases with information on over 2000 pieces of micro software in education at NWRL, TESOL and NABE and local conferences, and the CALL-IS users groups chairs. Vance Stevens, former chair of CALL-IS, was acting as an unofficial disseminator of public domain Apple software, but has moved out of the country and can no longer perform this function. Dissemination is very person-dependent at this time. A major happening that will greatly lower the cost of obtaining software and eliminate the licensing problems, and piracy is the growing body of public domain software. When programs are no longer profitable for a company, they are released into the public domain which means that they can be freely copied and distributed. Some programs suitable for CALL are now in the public domain. Stevens (in press) provides a review of some of them.

From this discussion it is clear that there is a strong need for instituting some kind of authoritative review process for ESL software. Reviews must be performed by persons knowledgeable about bilingual education, second language learning and teaching, and characteristics of good software. There is precedent for such work in the textbook adoption process and in the state review process for language proficiency measures, such as that implemented in California and Texas.

V: RESEARCH AND RECOMMENDATIONS

The introduction of new technologies and new types of educational programs for newly defined populations generally stimulates proposed research agendas (Center for Applied Linguistics, 1977-78; Watkins & Brimm, 1985). An agenda is needed for studying ways in which computers can be involved in promoting the development of English as a second language for elementary and secondary school students. At the present time there is little research on the topic, and few theoretical papers addressing research needs for this population. It is important to look at computer use from several perspectives. This review and agenda was developed by examining general research regarding children and microcomputers (see especially Chen & Paisley, 1985), considering current research in L2 development and bilingual education for elementary and secondary students (especially Wong-Fillmore et al., 1985, Ellis, 1984a, and Long & Porter 1985), and interviewing experts in the fields of CALL and the use of computers with LEP students in bilingual instructional settings. The research topics addressed include: (1) CAI/CALL feasibility and effectiveness studies, (2) issues of learning and transfer, (3) social interaction and status, and (4) learner characteristics.

Feasibility Studies and CAI vs. Non-CAI Comparison Studies

Dunkel, in her review of research on CALL (in press) points out that evidence for the effectiveness of CAI used as a replacement to traditional instruction is equivocal. When used as a supplement to regular instruction, however, findings have been more positive and have included more rapid learning. Dunkel states that the most damaging findings for CAI have come from a few studies documenting poor information retention She, however, feels that research should address not simply the effectiveness of CALL vs. non-CALL but cognitive and attitudinal variables, and issues such as confidence.

Tucker stresses recent evidence that while effects of computer-based teaching have been greater than programmed instruction and the use of

individualized packets, effects of peer tutoring and cross-age tutoring programs have been greater than effects of computer-based instruction (Tucker, 1983). CAI programs can be effective in certain situations, but in a complex educational environment it is not usually possible to attribute the success of a program to any one feature (Tucker, pc, Oct. 18, 1985).

A few studies have examined the feasibility of using microcomputers with LEP students and compared the English learning of CAI instructed students to the learning of control students taught by traditional methods. Ramos (1984), for example, conducted a dissertation study of this type. While treatment children scored higher than controls on measures of English, after seven weeks of instruction, there are several design features that make it impossible to attribute the gains to the treatment.

Research comparing one language teaching method to another, or bilingual education to alternative programs, has usually proven difficult to carry out and results are often inconclusive (Politzer, 1980; Douglas and Johnson, 1981). The same is probably true of studies comparing CALL with teacher-directed or other types of instruction. Because the use of microcomputers in schools and classrooms is increasing, there are many other questions that are of more interest at this stage.

Explicit and Implicit L2 Learning and Transfer

Since drill and practice software focusing explicitly on discrete skills is so widely used for English instruction with LEP students, and because current L2 acquisition theory posits that such practice is of very little value (Krashen, 1982), it would be important to conduct some small studies of the degree of spontaneous transfer of skills learned in microcomputer drill and practice programs to other situations. Bank Street researchers found that students who had spent a year learning to program did not improve in planning skills over a control group (Pea, Kurland & Hawkins, 1985). In like manner, drill and practice software including that designed for native English speakers and used with LEP

students may be inadequate for the development of generalizable second language skills, especially for the younger children. This is a critical concern that has not been well addressed in the general second language literature nor in the CALL literature. Drill and practice also puts a limitation on the variety of functional uses of English that children experience. " Without some functional significance to the activities,...there is unlikely to be successful, transferable learning (Pea, Kurland & Hawkins, 1985, p.211).

The flip side of the issue is an examination of incidental learning (Snow's term, 1985) in communicative CALL. We need research on how learning can be incidental in the context of an interesting CALL program in which the focus of the student is on the task to be accomplished or the message to be communicated, not the form. How are linguistic items and forms of expression learned in such environments and does the learning transfer to other situations? What are reasonable ways to draw on the computer for information about specific forms or meanings while working on a functional task? There is certainly evidence that students use each other as resources for this purpose. Chen, Lieberman & Paisley (1985) suggest that the microcomputer can invert the traditional learning process (from subskills to higher-level skills in context) by allowing children to move up and down the "skill ladder" between subskills and their integrated use.

Interactive Ennironments: Microcomputers/Students/Teachers/Peers

Interaction and L2 acquisiton. Interaction in a second language is important for second language development and computer work can be arranged to facilitate such interaction. A number of recent studies in second language acquisition have focused on interaction and its effects. One of the most important is the NIE-funded study conducted by Wong-Fillmore, Annon, McLaughlin and Annon (1985). They found that opportunities to interact with peers in English and actual interaction with peers in English correlated significantly with measures of gain in English language production. Hispanic students benefitted more from peer interaction than

Chinese students, who tended to profit more after reaching intermediate levels of English proficiency. Chinese students profitted more from interaction with teachers and lessons with teachers. These findings and those of other studies investigating interaction and L2 acquisition (Seliger, 1977; Wong-Fillmore, 1976; August, 1982; Johnson, 1983) make it clear that planned interaction is an important component of any L2 development program (Milk, in press).

While there is a significant amount of evidence that interaction influences the rate of L2 development, it is less clear how the interaction process affects what is learned. What occurs during interactions and how language learning occurs as a result has been a topic of recent research efforts (Gass & Madden, 1985; Long & Porter, 1985; Ellis, 1984a). Conversational modifications that occur as L2 learners converse and attempt to negotiate meaning are believed to be indirect causal variables in L2 acquisition (Long, 1985; Wong-Fillmore et al., 1985). Ellis also develops a good argument for the premise that linguistic knowledge is a by-product of communicative competence; that is, that linguistic knowledge is developed out of communicative interaction (Ellis, 1984a). This is consistent with the work by De Avila, Cohen, and Intili (1981) in which communicative interaction was centered around math and science lessons.

Computers and social effects. In the microcomputer literature a number of studies of children and adolescents have documented positive social effects of instructional work centered around computers. Lieberman (1985) cites a number of studies indicating that microcomputer activities lead to an increase in cooperative peer interaction and that such interaction is related to higher levels of interest, motivation, and achievement. The size of a group using a computer (individuals, pairs, groups of three or four) affects interaction patterns. Junior high students, for example, are more likely to tutor one another in pairs than in groups. They tend to work cooperatively when in pairs (triads competed more) and to give corrrect responses during instruction (Trowbridge & Durnin, 1984 cited in Lieberman, 1985).

Bork (1985) states that peer learning has long been recognized as an effective mode of learning but is underutilized in schools. After studying junior high students working individually, in pairs, or groups of three or four on computer-based math and science materials, he concluded that groups of two or three were the most desireable for mutual learning. In addition, he found unexpected learning resulting from peer pressure to correct spelling errors, for example. Bork recommends that students work together in groups of two or three because of the benefits for learning. A side benefit is, of course, reduced cost. He also recommends that software be developed that is designed for small groups with each person assigned a role. Because of the importance of interaction in the L2 for L2 acquisition, these findings suggest that peer and small group work centered around a computer-based activity can be a powerful force in a second language development program.

Status gained through computer use may be indirectly related to English acquisition. When students have confidence in their abilities and status among their peers, friendships and more interaction in English may result. A number of researchers have found that students who develop areas of expertise with computers gain status with their peers (Hakes, 1981; Levin & Kareev, 1980 cited in Lieberman, 1985; L. Maez, pc, July 25, 1985). COMSIS (1984) reports on a site in which aides in the Title VII computer lab program occasionally invited monolingual English speaking students into the lab and paired them with LEP students who taught them how to use the software. COMSIS reports that this practice enhanced the LEP students' self esteem.

Thus computer activities can serve as a catalyst that brings students together to interact, negotiate meaning, and negotiate strategies related to the task at hand. Teachers can structure lessons in ESL and in other subject areas to create such language learning opportunities. Future research could focus on ways of structuring the classroom and the lessons and the effects on language learning.

Learner Characteristics

There is a large body of research on the relationship between learner characteristics such as attitudes, motivation, personality, social skills and L2 learning (Wong-Fillmore, 1983; Dulay, Burt & Krashen, 1982), but little research on individual differences in interacting with computers for L2 learning. Chapelle (1983) has conducted one such study with college students. She found that the learner variables of field dependence and motivational intensity were positively related to time spent working voluntarily on PLATO CALL lessons and a positive attitude toward CALL. Stevens (1984) conducted an experiment comparing two CALL grammar lessons which differed in only one respect. In one version students were guided through the lesson in linear fashion, while in the other they could make choices about the order of presentation of the material. Stevens' data provide some evidence that students who were allowed to make choices learned more in a 35-minute period.

Because Wong-Fillmore et al. (1985) have found cultural differences between Chinese and Hispanic students in the ways in which they profit from different language-learning environments, it seems likely that there could be cultural differences in the way students interact with computer oriented activities. This is an area well worth exploring. The research by Hakes (1981) cited above represents one way of addressing cultural issues. An issue that may be related is sex differences in using computers. There is a fair amount of research on the topic in the general computer literature. Because so much of the software employs competition as a "motivator," it is also important to take into account research findings such as those of Peterson and Fennema (1985). They found some evidence that girls tended to profit more from cooperative math activities, while boys tended to profit more from competitive activities. Issues such as these should be considered in any software development and research projects.

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Recommendations

The recommendations are listed in order of priority.

1. Develop a model for incorporating the use of computers as tools into an integrated, nonremendial second-language program planned on a whole-day basis. The model would specify how existing software such as word processing, text generation programs, and other applications programs can be used in ways that promote L2 learning within the context of bilingual and other types of programs. The model would address grouping strategies and task structures building on research in child and adolescent second language acquisition and on the work done by researchers such as Mehan and colleagues and Pogrow.
2. Develop a manual for teacher training based on the model. At present there is little information for teacher training geared specifically for LEP students acquiring English, yet many universities are instituting training courses, and implementation proceeds in classrooms.
3. Promote the development of one or more prototype CALL lesson designs. The lesson format would provide a model and a structure for a content-based, communicative lesson. Such a lesson format would be theoretically sound, adaptable to different proficiency levels and different content. The documentation would then be made available to organizations or individuals who could carry on with development. This may be a cost effective way to provide leadership in the field of communicative CALL for LEP students.
4. Develop a set of criteria for evaluating CALL software. The criteria should be based on theory, research, and effective practice in ESL and bilingual education for LEP students. Evaluate software based on the published set of criteria and widely disseminate the analyses. This could be done on an ongoing basis with the information provided to users through an on-line network. Such information is sorely needed and would save users time and money.
5. Fund research on the research issues raised in this report. There is little research on which to base the design of sound second-language-learning designs that incorporate microcomputers.

6. Fund the development of a handbook for teachers.

The handbook would put forth in a clear, simple manner, second language acquisition theory, the model for incorporating microcomputers into the overall second-language-learning design, and specific lessons that teachers can use or use as models for developing their own lessons.

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